A paper on a similar subject was read by Mr. F. H. Alexander.

A long and elaborate paper, illustrated by numerous diagrams, was next taken. The subject was the structural arrangements of ships, the author being Mr. J. Bruhn. Details of tests of frame girders, on the strength of flanged plates, on intercostal stringers, on the tripping of frames, and the strength of rivet attachments, were described. The paper was of considerable professional interest, and will form a valuable source of information to naval architects; but without the aid of the numerous illustrations and diagrams it would be impossible to make the descriptions clear.

At the evening meeting of the same day a paper by Mr. R. E. Froude on hollow *versus* straight lines opened the proceedings. The subject has attracted a good deal of interest of late, and has already led to some discussion. A number of naval officers, led by Admiral Fitzgerald, hold that a great mistake is made by building ships for the Royal Navy with hollow lines. Sir William White and the other naval constructors naturally defend their practice, supporting their arguments by the actual results obtained at the Haslar tank. The naval men reply that, even allowing the superiority of hollow lines in the smooth water, at which all tank experiments were made, the hollow lines gave a slower vessel amongst waves, and also a wetter ship. In order to bring the matter to a practical issue, a number of experiments were made by Mr. Froude at the Haslar tank, in which artificial waves were created by a mechanical device. The results were plotted on diagrams attached to the paper, the general conclusion arrived at by Mr. Froude being that though there was a distinct diminution in average effective horse-power due to straight lines, yet this was insufficient to annul the greater efficiency of the hollow lines in smooth water. In the discussion that followed, Admiral Fitzgerald joined issue on this point. He held that quite smooth water was comparatively rarely met with at sea, and he considered it was a question for naval officers, and not for naval architects, to decide under which condition they would prefer the higher efficiency. Moreover, the straight lines gave greater displacement forward without extra cost, and the additional buoyancy could be used for placing heavier guns forward, or in other useful ways. Prof. Biles also joined in the discussion. He gave the results of trials on this subject made at the Dumbarton tank. These results were in contradiction to those given in Mr. Froude's paper, and until this discrepancy is explained the subject must remain unsettled. The need for an independent tank devoted to experimental investigation is apparent. Mr. Froude's experiments are extremely interesting, as being the first tank trials made in other than smooth water. When it is remembered how little smooth water there is at sea, and how widely the conditions of resistance and other qualities are altered by waves, the advantage of the new departure will be apparent.

An interesting paper by Mr. A. W. Johns, of the Royal Corps of Naval Constructors, was also read at this sitting, the subject being the effect of motion ahead on the rolling of ships. The subject is one both of interest and importance, and was worked out by the author with considerable ingenuity, theoretical results being compared with those obtained by experiment. It would appear that the effect of speed is to reduce rolling, but no doubt further tests will be made, the actual experimental data up to now being somewhat meagre.

Mr. Stromeyer also read a paper on the effect of acceleration on ship resistance.

Another paper was down for reading at this sitting, but unfortunately time did not permit of it being read. It was by Mr. S. Popper, of Pola, the subject being the results of model experiments in deep and in shallow water. The subject is one of considerable practical importance at the present time, when builders of destroyers in the south find it pays them to send their vessels to the measured mile on the Clyde, where there is deep water. They find the Clyde mile permits of a knot more being made than can be obtained on any of the comparatively shallow miles of the south.

On Friday, April 14, five papers were taken. Mr. A. E. Seaton contributed the first, the subject being margins and factors of safety and their influence on marine designs. Mr. J. H. Heck followed with some notes on the variation of angular velocity in the shafting of marine engines; and Mr. Mallock read a brief paper in which he described an ingenious device for keeping the two sets of engines of a twin screw vessel out of step, so as to prevent vibration. Mr. Attwood also read a paper on the Admiralty course of study for the training of naval architects.

Perhaps the most interesting paper of the meeting was that which came last. It was by Mr. J. B. Millet, of Boston, Massachusetts, and described a means of submarine signalling by sound, of which more will probably be heard in the future. Briefly it may be said that the sides of the ship itself are used as receivers. A tank filled with a dense liquid is attached to each side of the ship. In this a transmitter is placed, and the sound collected is taken by wires to an observer, who may be in any part of the vessel. If the source of sound is on the port side the sound will be apparent from the port transmitter; if on the starboard side the starboard transmitter will be affected; if it is directly ahead it will be heard equally through both transmitters. When the sound is astern a different effect is produced. As the result of practical trials, the positions of passing ships and of submarine bells were accurately defined. When it is remembered how untrustworthy sound signals are when passed through air, and how unchanging is the density of water, it will be seen that the new system promises to reduce the chief dangers of modern navigation, collisions, or strandings through fog. The idea of submarine sound signals, of course, is not new, but the hitherto insuperable difficulty in the way has been the confusion of sound through the overwhelming nature of the noises in the ship itself. Mr. Millet, however, appears to have overcome this difficulty, and the testimony as to the value of his invention is very strong.

The meeting was brought to a conclusion by the usual votes of thanks.

UNSOLVED PROBLEMS IN ELECTRICAL ENGINEERING.

ON April 10 Colonel R. E. Crompton delivered the annual "James Forrest" lecture of the Institution of Civil Engineers, an abstract of which is given below.

There are two groups of electrical problems, those which concern the scientific investigator and those presenting themselves to engineers. The lecturer dealt with the latter only. The phenomena of lightning discharges, especially where they affect the distribution systems of large electric power plants, require further study. Many failures are due to causes which the lecturer believes to be static discharges due to gigantic condenser effects set up in systems of well insulated overhead and underground conductors, each system acting as a plate of the condenser.

Interesting problems arise out of terrestrial magnetism; the present hypotheses are based on scant knowledge. It is known that the earth's magnetic field is not symmetrical, but the work of observing the variations of the earth's field at public observatories all over the world may eventually enable the earth's field gradually to be plotted out.

Another problem passing into the domain of engineering is the etheric transmission of power. What is now required is a better solution of the problem of producing continuous trains of Hertzian waves either by mechanical means or by electrochemical means.

The lecturer dealt rather fully with what he called the "core and coil" problem of electrical machinery, that is to say, the problems connected with the perfecting of the cores, hitherto of iron, but which in future may be made of some of the alloys invented by Dr. Huesler, which are now under test.

Dealing with the present means of using iron or steel castings of high permeability, the best methods were discussed of freeing them from blow-holes or porosity to ensure that the magnet cores should be of equal density of mass, and therefore of equal magnetic moment. In this connection the lecturer alluded to Prof. Barrett's discovery of

adding silicon, thereby increasing the fluidity and reducing the tendency to form blow-holes; he also gave reasons why increased permeability might be expected from this, as the addition of silicon probably acts by reducing the combined carbon in the iron, leaving the pure iron with a sponge or network structural formation calculated to give great freedom for molecular movement.

On the subject of coil winding, he showed by diagrams that at present the space occupied by insulation may be reduced by winding the copper upon the coils in the form of thin strip on edge, and insulating the portions from one another by a paint or varnish of sufficient dielectric strength, high heat conductivity, and power of retaining its dielectric strength at temperatures of 200° C. The thinness and fragility of the copper strip, however, demand that this should be done by a machine which will roll the copper to the section and curvature just as it is ready to be wound on. The difficulty was alluded to of designing the cores and windings of high-speed turbo-generators, owing to the trouble of resisting mechanical stresses due to centrifugal forces, and at the same time of subdividing them sufficiently to prevent the formation of eddy currents.

It was pointed out that although recently the developments of electrical storage have not been much discussed, it would be better to go on improving the lead couple accumulator we now have instead of waiting for the invention of some new storage couple which we may never obtain. The combination of the internal combustion engine driving a generator and worked by suction gas plant for long hours, thereby charging a battery of accumulators, is, if combined with a small steam plant capable of taking the peak load, probably the most economical method of producing energy for the short hours of lighting. Portable storage is much required for the modern automobile, and some progress has been made, but much still remains to be done. The lecturer did not believe that much could be gained from Edison's newly invented couple.

The utilisation of single phase alternating currents for railways is already within reach, the choice of systems lying between the Finzi type of series motors and the Winter and Eichsberg compensated repulsion motors. Electric traction can supersede existing steam haulage for passenger work at the present schedule speeds with economy and advantage. It is not quite certain that electric haulage will supersede steam haulage for high-speed passenger work, as, although undoubtedly electric haulage can work trains at 100 miles an hour, the steam locomotive can be improved to work at the same speed with equal safety. Engineers will not attack the long distance haulage of goods for years to come, at least not in our present state of knowledge of the cost of generating electrical energy. The successful development by electrical means of change speed and torque gear is much needed by the mechanical engineer, not only for railway work, but for rolling mills and similar purposes.

The measuring instruments used by electrical engineers have made great strides towards perfection, but there are some problems still unsolved, notably the power measurements of alternating currents.

Although there have been recently many attempts to improve the efficiency of electric lamps, both of the arc and incandescent type, yet much remains to be done. By using a beam of violet-blue light of considerable intensity it is nearly certain that many substances hitherto considered opaque, but which owe their opacity to the diffused refraction of the red and yellow rays, will be rendered transparent.

A problem of great importance will be the discovery of a direct method of producing cold by electric means, as by such methods cold storage will be facilitated in the larders of private houses.

Electric smelting has made great advances, and although it presents many unsolved problems, much may be hoped for in this direction.

The problem which is of the greatest interest to the world in general is the satisfactory development of power schemes by which the population can be sent back to the land. The solution is more difficult in this country, where we have no power supply from natural water power, but progress may nevertheless be expected.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT the graduation ceremony of Glasgow University on Tuesday, the degree of Doctor of Laws was conferred upon Prof. A. Crum Brown, F.R.S.

IT is announced by *Science* that gifts of 20,000*l.* to Rochester University for the construction of a scientific building, and of 10,000*l.* to Norwich University, Vermont, half for a library and half for an engineering department, have been announced. A donation of 50,000*l.* has been made to Northwestern University by Mr. Milton H. Wilson, a resident of Evanston, and one of the trustees of the institution.

REPLYING to a discussion on university education in Ireland which was raised on the Civil Service Estimates in the House of Commons on April 13, Mr. Balfour gave it as his opinion that Ireland is not provided for adequately in respect of university education. The decline in the number of students in Trinity College he ascribes to the great revolutions in the system of land tenure, which have diminished substantially the resources and the numbers of the class that send students to that institution. There is also a diminution of attendance at the Queen's College, Belfast, which is largely due to the influence which the Royal University is exercising on education in its higher forms by substituting a mere system of examination for a university training. Another reason for the falling off at the Queen's College is that the institution is without the funds necessary for complete equipment.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—"On the Absence or Marked Diminution of Free Hydrochloric Acid in the Gastric Contents in Malignant Disease of Organs other than the Stomach." By Prof. Benjamin **Moore,** in collaboration with Dr. W. **Alexander,** Mr. R. E. **Kelly,** and Mr. H. E. **Roaf.**

It has long been known that free hydrochloric acid is absent or reduced in amount in the great majority of cases of cancer of the stomach.

The absence of the acid in such cases has been attributed to local action, to continued irritation of the mucous membrane of the stomach by the presence of the growth, to retention of the food in the stomach acting as an irritant and causing gastritis when the growth has narrowed the pyloric opening, or to alkaline products thrown out at the seat of the growth and neutralising the acid.

The facts that the acid is not nearly so frequently absent in gastritis due to causes other than cancer of the stomach, and that the acid may be absent in cases of cancer and where there is no marked gastritis, and where the growth is confined to a small part of the mucous membrane, the remainder being normal, led to the surmise that the absence of free hydrochloric acid in the gastric secretion might not be due to local conditions in the stomach, but to a general condition of the blood which rendered it difficult or impossible for the oxyntic cells of the cardiac glands to secrete the acid.

To test this view, the amount of free hydrochloric acid in the gastric contents was determined in *seventeen* cases of malignant disease in which the growths were situated in regions remote from the stomach, such as tongue, cheek, floor of mouth, rectum, prostate, breast, and uterus.

As a result of the determinations it was found that free hydrochloric acid was either entirely absent (two-thirds of the cases) or greatly reduced in quantity. This shows that the absence of free hydrochloric acid in cancer of the stomach is not due to local action in that organ, but, on the other hand, that cancer, *wherever occurring,* is associated with diminution or absence of the acid from the gastric secretion.

Such a result can only arise by an alteration in the blood, which increases the difficulty of separating free hydrochloric acid by the secreting cells.

It is pointed out in the paper that the most probable alteration in the blood plasma increasing the difficulty of